Remarks

Claims 6 and 7 have been amended as suggested by the Examiner in paragraph 3 on page 2 of the Office Action dated October 7, 2005. Claims 8 and 9 are dependent claims based upon claim 7. Claim 7 is a dependent claim based upon claim 6. The Examiner's objections on page 2 of the Office Action now are overcome. The term "monitoring" in the claims has been changed to – controlling – since the latter term is more appropriate.

Claims 1-16 are rejected under 35 U.S.C. § 102(b) as being anticipated by reference Patent 5,713,814. Applicants request reconsideration of this rejection in view of the following remarks regarding distinctions between the teachings of the '814 reference patent and Applicants' claimed invention.

Applicants' invention is a closed loop control system that maintains a proper balance between battery power and engine power in a hybrid electric vehicle powertrain so that the battery power limits are not exceeded and engine power limits are not exceeded, and the actual battery usage is controlled to the battery power requested. The battery delivers power for the motor 46, which delivers driving power to the traction wheels through a powertrain gear system while the engine delivers power through a separate gear power flow path to the traction wheels. This involves the use of two controllers, shown at 58 and 60 in Figure 3 of Applicants' drawings. Controller 58 is part of a closed loop PID control that prevents actual battery power from exceeding battery maximum and minimum limits. A second controller, shown at 60 in Figure 3, is used to control battery charge or discharge by adjusting the engine power command. Because of the closed loop control characteristics of Applicants' invention, an error between the desired electrical power and the actual battery power determines a modification of the driver power request. Likewise, because of the closed loop characteristic of controller 60 of Applicants' invention, the error between battery power requested and the actual battery power determines a modification of the engine power requested. The actual battery power feedback loop is shown schematically in Figure 10 at 107.

Applicants' control system will adjust the battery power request in accordance with an energy management strategy that involves the use of an engine power command. By relying upon the engine to supply, when needed, a portion of the power required at the traction wheels, the actual battery power will be the same as the battery power request. Any unnecessary battery usage resulting from manufacturing variations or from varying environmental factors is minimized because of the closed loop characteristics of controllers 58 and 60, seen in Figure 3. In a similar fashion, Applicants' control system includes a transmission module that estimates the engine generated power based upon a driver demand for power. If the estimated engine power is not equal to the total power required at the wheels, the engine power will be supplemented by battery power to supply the deficiency.

The energy management strategy of Applicants' invention, which changes the engine power request to compensate for losses due to noise factors caused by manufacturing part variations and environmental factors, is a result of the closed loop operating characteristics of Applicants' system.

Figure 3 shows at 74 the actual battery power feedback term. This will ensure, by determining a modification of engine power requested and determining a modified battery power desired at 76, seen in Figure 3, that actual battery power usage is as intended (i.e., usage is the same as battery power requested), thus preserving battery life. The need for power at the wheels is satisfied. Thus, at all times during operation of Applicants' invention, a proper coordination of the power from the engine and from the battery will be achieved.

In contrast to the closed loop control system of Applicants' invention, the teachings of the '814 patent describe an open loop control system, which is used to switch the operating mode of the powertrain from a battery power mode to a power split mode when the battery is in a low charge state.

In the case of the control system of the '814 patent, the controller will switch the mode using information in a mode switching map depending upon the state of charge of the

battery. Depending upon the throttle setting, the powertrain will use the motor mode for small throttle settings and then will switch to a power split mode for large throttle settings. A switch from one mode to the other can also be achieved depending on the sensed state of charge. Another measured variable that will determine the mode in which the system will operate is the throttle setting. There is no suggestion in the teaching of the '814 patent, however, that a closed loop control strategy can be used in which the battery power and the engine power are continuously coordinated so that a power shortfall of one power source can be satisfied by the other power source. Applicants' system, furthermore, will accommodate differences between actual losses due to transient operating events and due to variations in power requirements caused by so-called noise factors. Applicants' system will provide battery power feedback to achieve correct engine power during operation so that battery power usage is kept within a battery operating range (battery power limits), and actual power usage is as intended; i.e., usage is the same as battery power requested..

Each of the claims includes limitations dealing with this closed loop feedback feature, whereby coordination between the two power sources is maintained. For example, claim 1 calls for controlling the actual battery power during operation using a closed loop feedback. It includes limitations calling for an adjustment of the battery power request during transient and steady state operating conditions due to changes in a request for engine power. Claim 6, for example, recites the step of coordinating the power delivery from the engine and from the battery and monitoring the battery power using a closed loop feedback so that unnecessary battery usage is minimized.

Claim 10 also recites a closed loop feedback system for monitoring actual battery power using first and second controllers, the second controller adjusting the battery power request during transient and steady state operation to change a request for engine power.

Claim 13 also recites a step for monitoring actual battery power using a closed loop feedback whereby the battery power request will result in a change in the request for

engine power, depending upon variable operating conditions. Claim 17 recites similar limitations dealing with the closed loop feedback system for monitoring actual battery power.

Claims 2, 3, 4, 5, 7, 8, 9, 11, 12, 14, 15, and 16 are dependent claims that depend upon the claims specifically discussed in the preceding paragraphs. They are patentable for the same reasons the base claims are patentable, but they include as well other limitations that distinguish the subject matter of those claims from the '814 patent. It is impossible to make a limitation-to-limitation comparison of Applicants' claims 1-6 with the teachings of the '814 patent in view of the fundamental distinctions between Applicants' closed loop controller and the open loop control system of the system of the '814 patent.

It is respectfully requested that claims 1-16 be allowed and that the Examiner issue a Notice of Allowance.

Respectfully submitted,

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